What is claimed is:

1. A method for making a silicon carbide composite material, comprising:

bringing at least two preforms into contact with one another at a location relative to one another at which said preforms are to be joined, each of said preforms being permeable to molten silicon or silicon alloy, and each containing at least some carbon;

placing at said location a carbon-containing adhesive, thereby joining one preform to the other;

curing said adhesive, thereby forming a bonded assembly of preforms;

providing an infiltrant material comprising silicon;

heating said infiltrant material to a temperature above the liquidus temperature of said infiltrant material to form a molten infiltrant material;

communicating said molten infiltrant material into contact with at least a portion of said bonded assembly;

infiltrating said molten infiltrant material into said bonded assembly, and reacting at least a portion of said silicon with at least a portion of said carbon to form a composite body comprising interconnected silicon carbide and a residual infiltrant phase comprising said silicon distributed throughout said interconnected silicon carbide, thereby forming a unitary silicon carbide composite body.

2. The method of claim 1, further comprising providing a mechanical locking system, said system comprising a key and keyway, said key comprising RBSC material, and said keyway comprising a hollowed-out region in said joined preforms, said keyway being positioned such that said location intersects said keyway, said keyway being of a size and shape as to engage said key; and placing said key into said keyway, thereby causing a mechanical locking action to occur.

3. The method of claim 1, wherein said preform further comprises at least one filler material.

4. The method of claim 2, wherein said filler material comprises at least one form selected from the group consisting of particulates, fibers, platelets, flakes, and reticulated structures.

5. The method of claim 1, wherein said preform comprises by volume about 5 percent to about 95 percent porosity.

6. The method of claim 1, wherein said preform comprises by volume from about 1 percent to about 10 percent of said carbon.

7. The method of claim 1, wherein said carbon is formed by introducing an organic-based resin into said permeable mass, and thermally decomposing the resin in a non-oxidizing atmosphere.

8. The method of claim 7, wherein said organic resin comprises a carbohydrate.

9. The method of claim 1, wherein said carbon is in the form of a reticulated structure.

10. The method of claim 2, wherein said carbon is in the form of a coating on at least a portion of said filler material.

11. The method of claim 2, wherein said filler material comprises a three-dimensionally connected structure.

12. The method of claim 1, wherein said filler material comprises at least one material selected from the group consisting of carbides, borides and nitrides.

13. The method of claim 1, wherein said infiltrant material comprises silicon and aluminum.

14. The method of claim 1, wherein said filler material comprises at least one material selected from the group consisting of silicon carbide, silicon nitride and titanium diboride.

15. The method of claim 1, wherein said infiltrant material comprises silicon and at least one metal selected from the group consisting of copper and zinc.

16. The method of claim 1, wherein said infiltrant material is heated to a temperature ranging from about 800 C to about 1800 C.

17. The method of claim 1, wherein said infiltrating is conducted in a non-oxidizing atmosphere.

18. The method of claim 1, wherein said infiltrating is conducted under vacuum.

19. A method for making a unitary silicon carbide composite body, comprising:

bringing at least two subunit preforms into contact with one another at a location relative to one another at which said preforms are to be joined, each of said preforms being permeable to molten silicon or silicon alloy, and each containing at least some carbon;

providing a key comprising a mechanical locking preform containing at least some carbon;

providing a keyway in said adjacent preforms, said keyway being of a size and shape as to engage said mechanical locking preform, and said keyway being placed at a location between said subunit preforms such that supplying of said key to said keyway will cause a mechanical locking action to occur;

placing said mechanical locking preform into said keyway, thereby restraining movement of one subunit preform relative to the other in at least one plane,a nd thereby forming an assemblage of preforms;

providing an infiltrant material comprising silicon;

heating said infiltrant material to a temperature above the liquidus temperature of said infiltrant material to form a molten infiltrant material;

communicating said molten infiltrant material into contact with at least a portion of said preform assemblage;

infiltrating said molten infiltrant material into said preform assemblage, and reacting at least a portion of said silicon with at least a portion of said carbon to form a composite body comprising interconnected silicon carbide and a residual infiltrant phase comprising said silicon distributed throughout said interconnected silicon carbide, thereby forming a unitary silicon carbide composite body.

20. The method of claim 19, wherein said preform comprises silicon carbide.

21. The method of claim 19, wherein said preform further comprises at least one filler material.

22. The method of claim 19, wherein at least a portion of said carbon of said preform is interconnected.

23. A method for making a unitary silicon carbide composite body, comprising:

bringing at least two subunit preforms into contact with one another at a location relative to one another at which said preforms are to be joined, each of said preforms being permeable to molten silicon or silicon alloy, and each containing at least some carbon;

providing a key comprising a mechanical locking reaction-bonded silicon carbide body;

providing a keyway in said adjacent preforms, said keyway being of a size and shape as to engage said mechanical locking body, and said keyway being placed at a location between said subunit preforms such that supplying of said key to said keyway will cause a mechanical locking action to occur;

placing said mechanical locking body into said keyway, thereby restraining movement of one subunit preform relative to the other in at least one plane, and thereby forming an assemblage of preforms;

providing an infiltrant material comprising silicon;

heating said infiltrant material to a temperature above the liquidus temperature of said infiltrant material to form a molten infiltrant material;

communicating said molten infiltrant material into contact with at least a portion of said preform assemblage;

infiltrating said molten infiltrant material into said preform assemblage, and reacting at least a portion of said silicon with at least a portion of said carbon to form a composite body comprising interconnected silicon carbide and a residual infiltrant phase comprising said silicon distributed throughout said interconnected silicon carbide, thereby forming a unitary silicon carbide composite body.

24. A method for making a unitary silicon carbide composite body, comprising:

bringing at least two subunit reaction-bonded silicon carbide (RBSC) composite bodies into contact with one another at a location relative to one another at which said RBSC composite bodies are to be joined;

providing a key comprising a mechanical locking preform containing at least some carbon;

providing a keyway in said adjacent RBSC composite bodies, said keyway being of a size and shape as to engage said mechanical locking preform, and said keyway being placed at a location between said subunit RBSC composite bodies such that supplying of said key to said keyway will cause a mechanical locking action to occur;

placing said mechanical locking preform into said keyway, thereby restraining movement of one subunit RBSC body relative to the other in at least one plane, and thereby forming an assemblage of RBSC bodies;

providing an infiltrant material comprising silicon;

heating said infiltrant material to a temperature above the liquidus temperature of said infiltrant material to form a molten infiltrant material;

communicating said molten infiltrant material into contact with at least a portion of said mechanical locking preform;

infiltrating said molten infiltrant material into said mechanical locking preform, and reacting at least a portion of said silicon with at least a portion of said carbon to form from said mechanical locking preform a composite body comprising interconnected silicon carbide and a residual infiltrant phase comprising said silicon distributed throughout said interconnected silicon carbide, thereby forming a unitary silicon carbide composite body.

25. A method for making a unitary silicon carbide composite body, comprising:

bringing at least two subunit reaction-bonded silicon carbide (RBSC) bodies into contact with one another at a location relative to one another at which said RBSC bodies are to be joined;

providing a key comprising a mechanical locking RBSC body;

providing a keyway in said adjacent RBSC bodies, said keyway being of a size and shape as to engage said mechanical locking RBSC body, and said keyway being placed at a location between said subunit RBSC bodies such that supplying of said key to said keyway will cause a mechanical locking action to occur;

placing said mechanical locking RBSC body into said keyway, thereby restraining movement of one subunit RBSC body relative to the other in at least one plane, and thereby forming an assemblage of RBSC bodies; and

heating said assemblage to a temperature above the melting point of said residual infiltrant material, thereby rendering said residual infiltrant within said subunit RBSC bodies molten, and thereby causing said molten infiltrant in adjacent bodies to fuse to one another across said boundary between said subunit RBSC bodies.

26. The method of claim 25, further comprising providing a source of infiltrant material to supplement said residual infiltrant material.

27. The method of claim 23, wherein said infiltrating is conducted in a temperature range of about 800C to about 1800C.

28. The method of claim 23, wherein said infiltrant material comprises silicon and aluminum.

29. The method of claim 23, wherein said infiltrant comprises by weight from about 10 percent to substantially 100 percent of said silicon.

30. A unitary reaction-bonded silicon carbide (RBSC) composite body, comprising:

a matrix phase comprising interconnected silicon carbide; and

a residual infiltrant phase comprising silicon distributed throughout said matrix phase, the unitary RBSC composite body further featuring indicia of being formed from the joining of two or more smaller structures, at least one of said indicia comprising a boundary between said smaller structures, the boundary comprising at least one of interconnected silicon carbide and interconnected residual infiltrant material extending across said boundary, thereby joining one of said smaller structures to an adjacent structure.

31. An article of manufacture selected from the group consisting of an air bearing support frame, a machine tool bridge, a machine tool base, and a beam for a machine that provides precision motion control in at least one dimension, said article comprising the unitary reaction-bonded silicon carbide composite body of claim 30.

32. The article of manufacture of claim 31, wherein said article comprises said beam, and further wherein said unitary RBSC composite body comprises a means for mechanically locking said two or more smaller structures to one another.

33. The method of claim 16, wherein said infiltrant material is heated to a temperature in the range of about 1100C to about 1500C.

34. A method for making a unitary composite body, comprising:

bringing at least two subunit preforms into contact with one another at a location relative to one another at which said preforms are to be joined, each of said preforms being permeable to a molten infiltrant, and comprising at least one filler material;

providing a key comprising a mechanical locking preform;

providing a keyway in said adjacent preforms, said keyway being of a size and shape as to engage said mechanical locking preform, and said keyway being placed at a location between said subunit preforms such that supplying of said key to said keyway will cause a mechanical locking action to occur;

placing said mechanical locking preform into said keyway, thereby restraining movement of one subunit preform relative to the other in at least one plane, and thereby forming an assemblage of preforms;

providing an infiltrant material;

heating said infiltrant material to a temperature above the liquidus temperature of said infiltrant material to form a molten infiltrant material;

communicating said molten infiltrant material into contact with at least a portion of said preform assemblage; and

causing said molten infiltrant material to infiltrate into said preform assemblage, to form an assemblage of composite bodies each comprising said at lest one filler material dispersed through a matrix phase comprising said infiltrant material, thereby forming a unitary composite body.